We claim:

1. A non-linear transmission line, comprising:

a non-parallel waveguide; and

a plurality of varactors in electrical communication with the non-parallel waveguide.

2. The non-linear transmission line of claim 1, wherein the plurality of varactors are configured to temporally reduce a signal applied to the non-linear transmission line.

3. The non-linear transmission line of claim 2, wherein the varactors are Schottky diodes.

4. The non-linear transmission line of claim 1, wherein the varactors are Schottky diodes.

5. The non-linear transmission line of claim 1, further comprising a semiconductor substrate and wherein the non-parallel guide is fixed with respect to the semiconductor substrate.

6. The non-linear transmission line of claim 5, wherein the varactors are Schottky mesa diodes defined on the semiconductor substrate.

7. A non-linear transmission line, comprising:

a plurality of varactors; and

an enhanced-delay waveguide in electrical communication with the plurality of varactors.

8. The non-linear transmission line of claim 7, wherein the varactors are situated so that the non-linear transmission line is a shockline.

9. A non-linear transmission line, comprising:

a substrate;

a plurality of varactors; and

a waveguide defined with respect to the substrate, the waveguide including an airbridged portion configured to control a waveguide propagation characteristic.

10. The non-linear transmission line of claim 9, wherein the waveguide is a non-parallel waveguide.

11. The non-linear transmission line of claim 10, wherein the non-parallel waveguide includes a conductor that is airbridged and is electrically connected to the plurality of varactors so as to temporally reduce an electrical signal applied to the non-linear transmission line.

12. The non-linear transmission line of claim 10, wherein the non-parallel waveguide includes a gap configured to receive the plurality of varactors so as to temporally reduce an electrical signal applied to the non-linear transmission line.

13. The non-linear transmission line of claim 9, wherein portions of the conductors are substantially airbridged near the plurality of varactors.

14. The non-linear transmission line of claim 9, wherein the waveguide is a non-parallel waveguide that includes a first conductor and a second conductor.

15. The non-linear transmission line of claim 14, wherein at least one of the first conductor and the second conductor includes at least one linear segment.

16. The non-linear transmission line of claim 9, wherein the waveguide is a non-parallel waveguide that includes a periodically repeated waveguide section.

17. A non-linear transmission line configured to temporally reduce an electrical signal, comprising:

a semiconductor substrate;

a non-parallel waveguide; and

a plurality of semiconductor junctions distributed along the non-parallel waveguide and electrically connected to the non-parallel waveguide.

18. The non-linear transmission line of claim 17, wherein the non-parallel waveguide includes a first conductor and a second conductor, wherein the plurality of semiconductor junctions are electrically connected to the first conductor and the second conductor.

19. An electrical pulse generator, comprising:

a pulse source configured to produce an unprocessed electrical pulse;

a mode converter configured to receive portions of the unprocessed electrical pulse at a first input and a second input, and to provide a processed electrical signal at a first output and a second output, wherein the processed electrical signal is a differential electrical signal

20. The electrical pulse generator of claim 19, wherein the mode converter includes:

(a) a first waveguide configured to deliver a portion of the unprocessed electrical signal to the first output;

(b) a second waveguide configured to receive a portion of the unprocessed electrical signal; and

(c) an inverting waveguide configured to invert the portion of the unprocessed electrical signal received from the second waveguide and to deliver the inverted portion to the second output, whereby a processed electrical signal is delivered to the first output and the second output.

21. The electrical pulse generator of claim 20, wherein the first, second, and inverting waveguides are coaxial cables.

22. The electrical pulse generator of claim 21, wherein the second and inverting waveguides include respective inner conductors and outer conductors, and the inner conductor and the outer conductor of the second waveguide are electrically connected to the outer conductor and the inner conductor, respectively, of the inverting conductor.

23. The electrical pulse generator of claim 21, further comprising a mode filter configured to enhance a magnitude of a differential mode electrical signal in the processed electrical signal

24. The electrical pulse generator of claim 21 further comprising a shockline configured to receive portions of the unprocessed electrical signal from the first input waveguide and the inverting waveguide and to produce a temporally reduced electrical signal.

25. A pulse generator, comprising:

a pulse source that produces an electrical pulse; and

a non-linear transmission line that includes a non-parallel waveguide and a plurality of varactors in electrical communication with the non-parallel waveguide, wherein the non-linear transmission line is configured to receive the electrical pulse and deliver a processed electrical pulse.

26. The pulse generator of claim 25 wherein the processed electrical pulse is temporally reduced.

27. A mode filter for producing a differential pulse, comprising:

a first waveguide; and

a second waveguide, wherein a common mode impedance of the first waveguide and a common mode impedance of the second waveguide are mismatched and a differential mode impedance of the first waveguide and a differential mode impedance of the second waveguide are matched.

28. The mode filter of claim 27, wherein the common mode impedance of the first waveguide is about 25 Ohms and the common mode impedance of the second waveguide at least about 100 Ohms.

29. The mode filter of claim 28, wherein the differential mode impedances of the first waveguide and the second waveguide are approximately equal.

30. The mode filter of claim 29, where the differential mode impedances are about 50 Ohms.

31. An apparatus for electrically connecting a transmission line interior conductor to a conductor pad on a substrate, comprising:

a rod configured to contact the interior conductor; and

a spring configured to urge the rod toward the interior conductor, thereby urging the transmission line conductor towards the conductor pad.

32. An apparatus for electrically connecting to a substrate, comprising:

an airline that includes an airline conductor and an airline housing, wherein the airline conductor is situated within the airline housing; and

means for urging the airline conductor towards the substrate.

33. A sampler, comprising:

a signal conductor;

a sampling diode in electrical communication with the signal conductor; and

a non-linear transmission line that includes a non-parallel waveguide and a plurality of varactors, the non-linear transmission line configured to deliver sampling strobe pulses to the sampling diode.

34. The sample of claim 33, further comprising an intermediate frequency (IF) waveguide configured to electrically connect to the signal conductor as controlled by the sampling diode.

35. The sampler of claim 34, further comprising a measurement system configured to receive portions of an electrical signal applied to the signal conductor from the IF waveguide.

36. The sampler of claim 35, wherein the measurement system is configured to produce an equivalent-time representation of the electrical signal.

37. The sampler of claim 34, further comprising a measurement system configured to receive portions of an electrical signal applied to IF waveguide from the signal conductor.

38. The sampler of claim 37, wherein the measurement system is configured to produce an equivalent-time representation of the electrical signal.

39. The sampler of claim 33, wherein the non-linear transmission line includes a plurality of Schottky mesa diodes.

40. The sampler of claim 33, wherein the non-parallel waveguide includes at least one periodically repeated waveguide section.

41. The sampler of claim 33, further comprising a strobe waveguide transition configured to receive the sampling strobe pulses from the non-linear transmission line and to deliver enhanced strobe pulses to the sampling diode.

42. The sampler of claim 33, wherein the non-parallel waveguide is a slotline.

43. The sampler of claim 33, wherein the non-parallel waveguide is a coplanar stripline.

44. A sampling circuit, comprising:

a first waveguide configured to receive a sampling strobe and having a first impedance;

a second waveguide configured to receive the sampling strobe from the first waveguide and having a second impedance, wherein the first impedance and the second impedance are configured to produce an enhanced sampling strobe; and

at least one diode electrically controlled by the sampling strobe and configured to deliver a sampled portion of an input signal to an output conductor.

45. The sampling circuit of claim 44, wherein the second waveguide includes a termination configured to direct an inverted portion of the enhanced sampling strobe to the sampling diode, thereby establishing a sampling window.

46. The sampling circuit of claim 45, wherein the first waveguide and the second waveguide are slotlines.

47. The sampling circuit of claim 45, further comprising an IF waveguide configured to deliver the sampled portion to the output conductor.

48. A method of temporally reducing an electrical signal, comprising:

providing a non-linear transmission line that includes a non-parallel waveguide; and

directing the electrical signal to the non-linear transmission line.

49. A method of delivering an electrical signal to a substrate, comprising:

configuring an airline to receive the electrical signal; and

urging an interior conductor of the airline into electrical communication with the substrate.

50. The method of claim 49, wherein the airline has a characteristic impedance corresponding to a characteristic impedance of a transmission line from which the electrical signal is received by the airline.

51. The method of claim 50, wherein the characteristic impedance is about 50 Ohms.

52. A method of producing a differential pulse from a common mode pulse, comprising:

splitting the common mode pulse into at least two portions; and

directing at least one portion to a common mode to differential mode converter.